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GROWTH AND SURVIVAL OF NORTHERN HARDWOOD SPROUTS AFTER BURNING

DONALD A. PERALA

Associate Silviculturist, Northern Conifers Laboratory
Grand Rapids, Minnesota

ABSTRACT.--Root collar sprouting of nine hardwoods was measured annually after a prescribed burn. Basswood, red oak, and paper birch were the most vigorous sprouters; sugar maple and yellow birch the least; and American elm, bur oak, ironwood and red maple were intermediate. Parent tree diameter influenced sprouting.

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Most northern hardwoods will sprout from dormant or adventitious buds in the root collar. Sprouts occasionally form on standing live trees but sprouting is most vigorous after the bole is felled or killed such as by fire. Sprout regeneration of some species, such as basswood (*Tilia americana* L.), are managed for sawtimber. But sprout regeneration of most species, particularly sugar maple (*Acer saccharum* Marsh.), seldom develop into high quality trees. Sprouts of many species are favored foods of white-tailed deer; thus, they also are important in wildlife management.

Sprouting ability after felling ranges from very little in yellow birch (*Betula alleghaniensis* Britton) (Solomon and Blum 1967) to highly vigorous in basswood (Eyre and Zillgitt 1953). Comparative data on early growth and survival of northern hardwood sprouts after fire, which had not been available previously, are reported in this Note.

METHODS

A total of 341 trees representing 9 species (table 1) on the Chippewa National Forest, Minnesota, were stem killed by a prescribed burn in aspen (*Populus tremuloides* Michx.) slash on May 17, 1967. About 18 ovendry T ha^{-1} of slash were consumed at a mean fire energy output rate of 5800 cal s^{-1} cm^{-1}. All trees not killed by the fire were felled to eliminate overstory competition and to provide uniform sprouting conditions. The soil was a Warba very fine sandy loam with clay loam subsoil. For more detail on the burn and study area see Perala (1974).

Each year for 5 years, live sprouts were measured for diameter to the nearest 0.25 cm at 30 cm up the stem and for total height to the nearest 30 cm. This was summarized as $\Sigma\ (d^2h)$ for each sprout clump. Ovendry weight of sprout clumps was estimated using this equation (Perala 1973):

$$TW = \exp\ [-3.264 + .0941 \log_e \Sigma\ (d^2h) + 0.38\ Age^{-1}]$$

where TW = ovendry weight of stemwood, bark, and branches; exp = logarithm base e; and Age^{-1} = inverse of stem age. TW was adjusted for the particular specific gravities (USDA Forest Service 1955) and branch:stem ratios (Young and Carpenter 1967) of each species.

RESULTS

Sprouting began within a few weeks after the burn. Sprouts commonly originated on the stump at ground line but some American elm (*Ulmus americana* L.) and occasional sugar maple sprouts originated from shallow roots in the humus up to 1.5 m away.

Sprouting percent.--For yellow birch, 38 percent sprouted during the first year but declined steadily during the remaining years. For the other species, sprouting percent reached a maximum the second year and remained constant thereafter. At the end of 5 years, sprouting ranged from 11 percent for yellow birch to 100 percent for both ironwood (*Ostrya virginiana* (Mill.) K. Koch) and basswood (table 1).

Sprout production and mortality.--Paper birch (*Betula papyrifera* Marsh.), red maple (*Acer rubrum* L.) and basswood sprouts were most numerous the first year; American elm, red oak (*Quercus rubra* L.), sugar maple, and yellow birch, the second year; and bur oak (*Quercus macrocarpa* Michx.), the third year. Ironwood had nearly equal numbers of sprouts each year because mortality was offset by new sprouts. Other species also produced a few new sprouts annually but their mortality was much higher than new production after they reached maximum sprout numbers. Dominant sprouts seldom died so mortality was largely limited to the smallest sprouts. The greater the number of sprouts produced, the greater number of sprouts that survived except for ironwood and for paper birch, which ranked third in sprout production but suffered the highest mortality rate--(74 percent after 5 years). American elm had the lowest mortality rate (30 percent) so it had the most sprouts per clump after 5 years; yellow birch had the least (table 1).

Sprout growth.--Basswood, red oak and paper birch had the tallest sprouts after 5 years (table 1). Basswood and red oak had by far the greatest clump dry weight growth: 1.5 to 25 times more than the others (fig. 1).

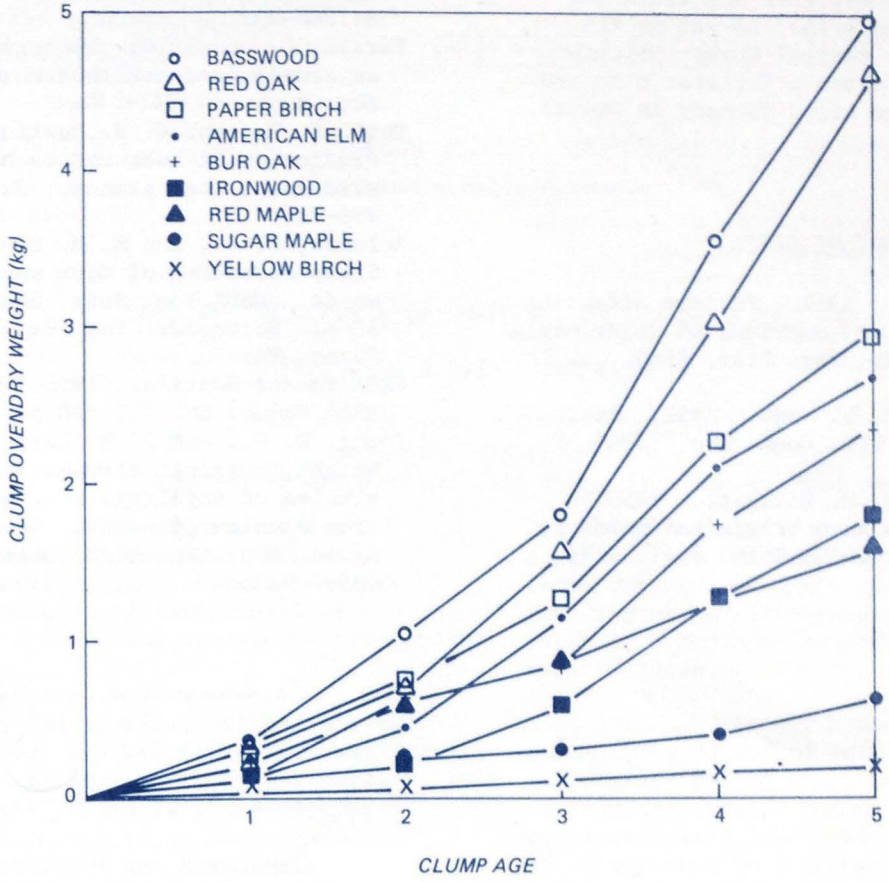
Size of parent tree.--The larger parent tree diameters at breast height (dbh) generally were associated with a greater percent of stumps sprouting, greater numbers of sprouts, and greater growth for basswood, paper birch, and red maple. In contrast sugar maple sprouting decreased with greater dbh, as had been observed by

Table 1.--*Sprouting characteristics of nine northern hardwoods 5 years after a prescribed burn*

Species	Number observed	Dbh range	Sprouting frequency	Mean sprout height[1/]	Sprouts per clump	Dry weight per clump
		cm	*Percent*	*m*		*Kg*
Basswood	48	10-43	100	2.9	21	4.9
Northern red oak	16	10-51	87	3.0	13	4.6
Paper birch	82	10-38	89	3.0	10	2.9
American elm	13	10-36	61	2.0	37	2.6
Bur oak	20	10-41	60	2.5	21	2.3
Ironwood	5	10-13	100	2.4	32	1.8
Red maple	75	10-25	99	2.4	15	1.6
Sugar maple	61	10-38	85	1.7	13	0.6
Yellow birch	21	10-58	11	1.2	5	0.2

[1/] Based on three tallest sprouts per clump.

Figure 1.--*Sprout dry matter accumulation (stemwood, bark, and branches per sprout clump).*



Church (1961) and Solomon and Blum (1967). But opposite results for red maple also agreed with Solomon and Blum's observations of increasing numbers of sprouts up to 20 cm dbh but we didn't have any large red maple to compare with the decline they found with greater tree diameters. The positive sprouting response we observed for paper birch to dbh contrasts with those of Solomon and Blum, who reported they were unable to relate sprouting to diameter for paper birch. We found that small- to intermediate-size paper birch produced the most vigorous sprouts, as had been observed by Duda and Nash (1951). However, we also found that large paper birch sprouted nearly as well. Basswood sprouting was vigorous over a wide range of diameters although 15 cm dbh appears to produce the largest stems. There were not enough observations for the other five species to relate sprouting with tree dbh.

SUMMARY AND CONCLUSIONS

Basswood was the most vigorous root collar sprouter followed closely by red oak and paper birch. Sugar maple was a poor sprouter. It ranked ahead of only yellow birch, which Solomon and Blum (1967) reported to be a feeble sprouter in the northeast.

Root collar sprouting was neither particularly hindered nor aided by burning. However, burning did encourage sprouting to initiate close to ground line. This is beneficial to red oak because decay entrance from the parent tree is reduced (Roth and Hepting 1969). More investigation is needed to determine if other species also may benefit from low sprouting induced by fire.

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